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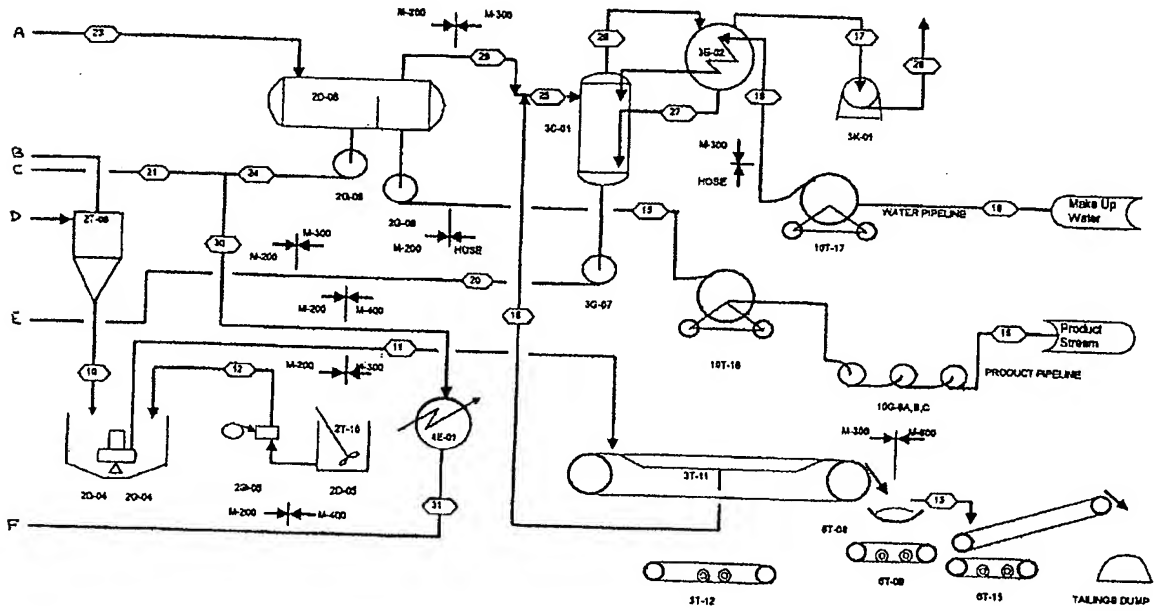
(54) Titre : APPAREIL ET METHODE DE RECUPERATION DU BITUME DES SABLES BITUMINEUX
(54) Title: APPARATUS AND METHOD FOR THE RECOVERY OF BITUMEN FROM TAR SANDS



AN ALTERNATIVE FOR THE RECOVERY OF BITUMEN FROM THE ATHABASCA TAR SANDS

Summary:

This document presents an alternative process for the recovery of bitumen from the Athabasca tar sands. Current technology is limited in its applicability, environmental acceptability, cost and therefore, in its overall efficacy. A typical operation for a 100,000 barrel/day bitumen production facility costs over $1 billion to build and over $5.00 /barrel to operate while having significant environmental debits.

The following alternative offers an environmentally superior process and applicability in relatively small increments. It is forecast to cost about $500 million to build a 100,000 barrel/day bitumen production facility which would have an equivalent operating cost of $2.58 /barrel.

Introduction:

The Athabasca tar sands in northeastern Alberta are estimated to contain some 300 billion barrels of bitumen heavy oil. Of this total, some 80 billion barrels have been estimated to be accessible for recovery through surface mining methods.

The Suncor Energy predecessor, Great Canadian Oil Sands, initiated commercial operation employing the current technology of bitumen recovery from the tar sands in 1967. Subsequently, Syncrude Canada Ltd. commenced operation in 1978. These two operations, the only ones based on tar sand mining, recover a total of approximately 400,000 barrels of bitumen per day. In both companies the technology employed has developed little since the mid 1960s, although there have been changes in mining methodology. The original mining operations, at GCOS were based on bucketwheel excavator mining and conveyor transport and at Syncrude on dragline excavation, bucketwheel reclaim and conveyor transport. These technologies were selected at the inception of these projects, over shovel mining and truck haulage, because large shovels and trucks had not been developed by that time.

Current Technology

The bitumen recovery from surface mined tar sands entails the following steps:

- Mine dewatering and muskeg removal
- Overburden stripping and haulage
- Construction of tailings pond starter dikes with overburden
- Ore mining and haulage
- Ore preparation (size reduction and water addition to form a slurry)
- Hydro-transport of the ore slurry to processing plants by way of pumps and pipelines
- Bitumen flotation as an aerated froth by way of thickener type vessels and air induced flotation cells.
- Tailings disposal by hydro-transport to tailings ponds
- Reclaim of water from the tailings ponds and its re-circulation to processing plants

- Reclaim and re-handling of fine solids sludge from the tailings ponds to mix with coarse tailings in the manufacture of consolidated tailings.
- Continuing construction of tailings pond dikes
- Removal of air, bulk water and coarse solids from the aerated bitumen froth
- Removal of remaining water and solids from the bitumen
- Upgrading of the bitumen to synthetic crude oil products
- Remediation of tailings ponds and reforestation of disturbed land areas

This recovery process requires transport of massive quantities of overburden and other waste material, tar sand ore and the attendant large quantities of water over very long distances. The bitumen comprises only about 7-12% of the ore mass, rendering the scheme largely a material handling undertaking. The support facilities, equipment, personnel and energy requirements are correspondingly massive and expensive.

Costs Based on Current Technology

The development and installation of a tar sand facility capable of producing about 100,000 barrels per day of aerated bitumen froth is estimated to cost over $1 billion Canadian. The attendant operating costs are estimated to run at about $5.50 Canadian per barrel of this raw bitumen froth.

Alternative Technology

Over the last few years, two engineers each with over 25 years of experience in all aspects of the specification, conceptual and process design as well as detailed design, installation, startup and operation, have developed an alternative to the above technology. The two engineers, Bill Lavender and Harry Kaethler, have worked together over many years. They are convinced that this alternative technology has the potential to revolutionize the industry.

Their detailed estimates indicate a capital cost of approximately $500 million Canadian for a 100,000 barrels per day bitumen production facility. This facility would have an operating cost of approximately $2.58 Canadian per barrel of bitumen. As well, their scheme can be implemented in 25,000 barrel per day increments without significant economic penalty. This provides a way for small operators to start in the business without economic disadvantage.

This technology enjoys very substantial advantage over the current technology in the environmental and conservation areas of:

- Much higher energy efficiency and attendant much lower carbon dioxide generation.
- Much smaller disturbed land footprint.
- No tailings ponds with the attendant need for remediation, a significant end of project cost and a matter of public concern.
- Concurrent land reclamation and re-vegetation.
- No ore sterilization by tailings ponds because there are none.
- The economic superiority allows the recovery of ore that under current technology is marginal due to its grade and/or overburden stripping ratio. This increases the value of the ore reserve.
- Much reduced air pollution from diesel fueled vehicles.
- Much reduced draw on fresh water resources.

The Proposal

To assess the potential of this alternative technology and develop the necessary engineering criteria for commercial implementation, it is proposed that a development program be undertaken. This program would involve testing of the key scheme elements, in full scale. All of these key elements are in commercial use in other industries and can be classed as "off-the shelf". Scale-up risk is eliminated because it is feasible and practical to test, in full scale, the sub-elements of which the key elements are comprised.

The testing is to take place in the field, on representative ore in order to eliminate the risks typically encountered in the implementation of projects from laboratory to commercial scale. This testing program is not a piloting program and consequently is much less costly than some of the programs that the industry has undertaken over the years.

This program of testing the key elements, together with a $1 million allowance to purchase access to a suitable lease, development engineering including a feasibility study pertaining to a specific ore body/lease, is valued at $4 million Canadian and is expected to be performed over a six month period.

It is the source of funding for this development program that is being sought. In return for providing the funds the funding agency would acquire an equity position in the commercialization of this new technology, the share to be negotiated.

STREAM NO.		1	2	3	4	5	6	7	8	9	10
DESCRIPTION	UNITS	TAR SAND	SLURRY WATER	1st STG FEED	1st STG U/F	2nd STG FEED	2nd STG O'FLOW	2nd STG U'FLOW	3rd STG FEED	3rd STG O'FLOW	3rd STG U'FLOW
BITUMEN	t/h	240	1	151	45	80	42	18	21	15	6
WATER	t/h	100	735	2124	637	2205	1544	661	2169	1568	601
SOLIDS	t/h	1660	32	1861	1638	1853	222	1631	1792	215	1577
TOTAL	t/h	2000	768	4136	2320	4118	1808	2310	3982	1798	2184
BITUMEN	wt %	12.0	0.1	3.7	1.9	1.5	2.3	0.8	0.5	0.8	0.3
WATER	wt %	5.0	95.7	51.3	27.5	53.5	85.4	28.6	54.5	87.2	27.5
SOLIDS	wt %	83.0	4.2	45.0	70.6	45.0	12.3	70.6	45.0	12.0	72.2
HEAT CAPACITY	Btu/lb/F	0.295	0.948	0.623	0.44	0.635	0.876	0.446	0.64	0.886	0.437
SPECIFIC GRAVITY		1.44	1.03	1.72	2.15	1.72	1.17	2.16	1.72	1.16	2.18
TOTAL VOLUME	USGPM		2983	9619	4316	9577	6181	4278	9260	6200	4007
	ACFM										
TEMPERATURE	DEG F	32	195	145	145	160	160	160	170	170	170

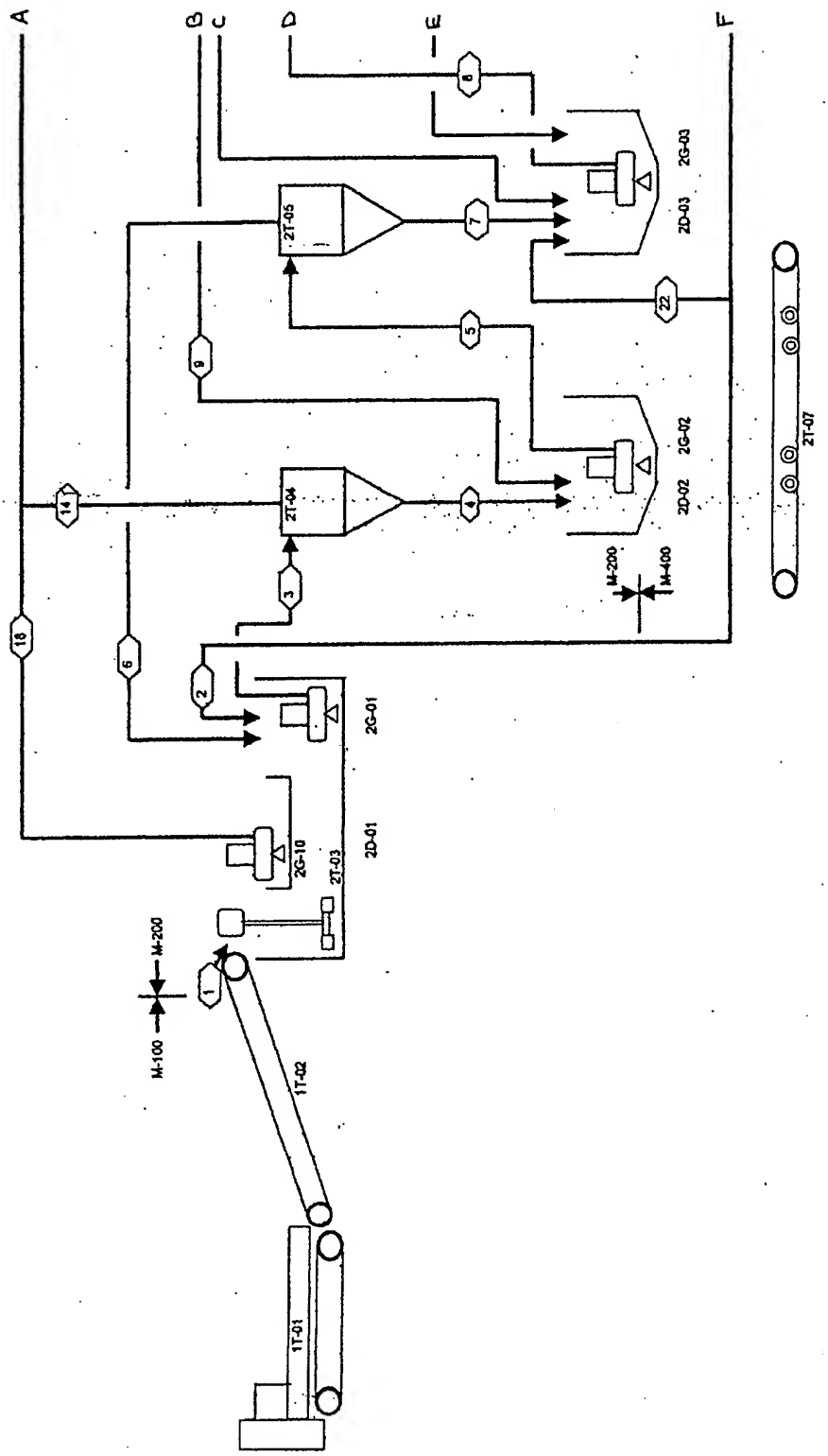
MATERIAL BALANCE

11	12	13	14	15	16	17	18	19	20	21	22
FILTER FEED	FLOCC FEED	DRY TAILINGS	1st STG O'FLOW	PRODUCT	FILTER EFFLUENT	FILTER VACUUM	PRIMARY FROTH	MAKE-UP WATER	WATER RECYCLE	HOT WATER BYPASS	3rd STG FEED WTR
6	0	6	105	233	0	0	132	0	0		4
603	2	272	1487	108	331	1	255	279	613		895
1577	0	1577	223	83	0	0	53	0	0		161
2186	2	1855	1815	424	331	1	440	279	613		1060
0.3	0.0	0.3	5.8	55.0	0.0	0.0	30.0	0.0	0.0		0.4
27.6	100.0	14.7	81.9	25.5	100.0	100.0	58.0	100.0	100.0		84.4
72.1	0.0	85.0	12.3	19.5	0.0	0.0	12.0	0.0	0.0		15.2
0.437	0.98	0.341	0.857	0.922	0.98	0.98	0.731	1	0.98		0.865
2.18	0.96	2.4	1.17	1.32	0.96	0.96	1.18	1	0.98		1.22
4011	8		6205	1285	1379	4	1429	1116	2502		3475
170	80	170	145	145	170	160	145	35	100		195

23	24	25	26	27	28	29	30	31
COMBINED FROTH	PRODUCT WATER RECYCLE	VACUUM RECEIVER INLET	VACUUM RECEIVER OVHD	VACUUM CONDSTE	VACUUM EXHAUST	PRODUCT DRUM VAPOUR	PRODUCT WATER RECYCLE	HOT PROD WATER RECYCLE
238	5	0	0	0	0	0	5	5
1742	1630	335	4	1	1	4	1630	1630
276	193	0	0	0	0	0	193	193
2256	1828	335	4	1	1	4	1828	1828
10.5	0.3	0.0	0.0	0.0	0.0	0.0	0.3	0.3
77.2	89.2	100.0	100.0	100.0	100.0	100.0	89.2	89.2
12.2	10.5	0.0	0.0	0.0	0.0	0.0	10.5	10.5
0.832	0.9	0.98		1			0.9	0.9
1.17	1.14	0.96	0.96	0.96	0.96	0.98	1.14	1.14
7713	6414	1306	17	4	4	18	6414	6414
					1000			
145	145	168	168	165	160	145	145	195

EQUIPMENT LIST

TAG NO.	NAME	TAG NO.	NAME
3C-01	VAC. K.O. DRUM	3K-01	VACUUM PUMP
C-02	not used		
		1T-01	MINING MACHINE
2D-01	SLURRY FD TK	1T-02	ORE FEED CONVEYOR
2D-02	CYCLONE 04 UF SUMP	2T-03	ORE FEED MIXER
2D-03	CYCLONE 05 UF SUMP	2T-04	1st STAGE CYCLONE
2D-04	CYCLONE 06 UF SUMP	2T-05	2ndSTAGE CYCLONE
2D-05	FLOCCULANT TANK	2T-06	3rdSTAGE CYCLONE
2D-06	PRODUCT SEPARATOR	2T-07	EXTRACTION CARRIER
"4E-01"	MAKE UP WATER HTR	6T-08	TAILINGS CONVEYOR
"3E-02	VAC OVHD CONDENSER	6T-09	TAILINGS CONVEYOR CARRIER
2G-01	FRESH FEED PUMP	2T-10	FLOCCULANT MIXER
2G-02	CYCLONE 05 FD PUMP	3T-11	VACUUM FILTER
2G-03	CYCLONE 06 FD PUMP	3T-12	VACUUM FILTER CARRIER
2G-04	BELT FILTER FEED PUMP	6T-13	TAILINGS CONVEYOR BELT WAGON
2G-05	FLOCCULANT PUMP	10T-14	ELECTRIC CABLE WAGON
2G-06	PRODUCT PUMP	6T-15	TAILINGS STACKER
3G-07	RECYCLE WATER PUMP	10T-16	PRODUCT HOSE REEL
10G-8A,B,C	PRODUCT PIPELINE PUMPS	10T-17	WATER HOSE REEL
2G-09	PRODUCT WATER RECYCLE		
2G-10	PRIMARY FROTH PUMP		


A
B
C
D
E
F
1T-01
1T-02
2T-03
2T-04
2T-05
2T-07
2G-01
2G-02
2G-03
2G-10
2D-01
2D-02
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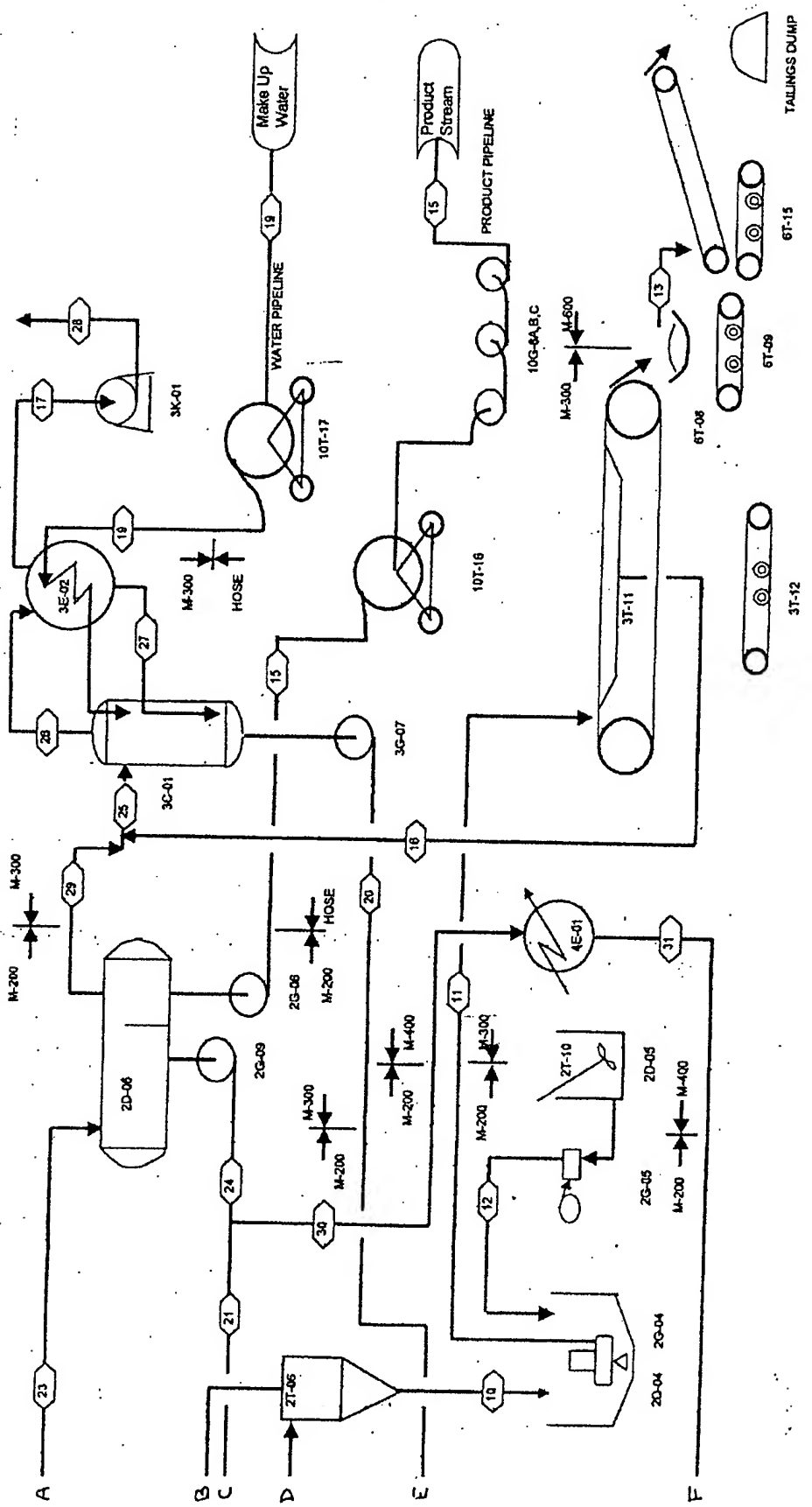
Make Up Water
Product Stream
PRODUCT PIPELINE
WATER PIPELINE
TAILINGS DUMP
3K-01
3E-02
3C-01
3G-07
10T-17
10T-16
10G-4A,B,C
3T-11
3T-12
6T-15
6T-09
6T-08
4E-01
2D-06
2D-05
2D-04
2T-10
2T-06
HOSE
M-300
M-200
M-400
M-600
A
B
C
D
E
F